

MEDICINE LAKE NATIONAL WILDLIFE REFUGE

MEDICINE LAKE, MONTANA

ANNUAL WATER MANAGEMENT PLAN

1981 Water Use Data

1982 Recommendations

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

MEDICINE LAKE NATIONAL WILDLIFE REFUGE

MEDICINE LAKE, MONTANA

ANNUAL WATER MANAGEMENT PLAN - 1982

I. Record of 1981 Water UseA. Source of Supply

Severe drought continued throughout the winter and spring period. Although the amount of water that was received tripled over the previous year, it was still insignificant to our total needs. Spring runoff was the third lowest in the last twenty years but more significantly, the three low run-off periods have occurred in the last five years. The drought, which has existed over the last two years, has dropped our water reserves to their lowest point since the late 1930's when the refuge was completely dry. Significant rains during the month of June raised water levels slightly but no run-off was received. The east impoundment areas of the refuge benefited from an increased flow in Cottonwood Creek but the main lake received only water from the Big Muddy Creek and did not show any substantial elevation changes. The Homestead Unit received no run-off water and was only partially filled when we released water from the main lake through number 4 structure.

B. Type of Rights

The U.S. Fish and Wildlife Service through filings posted and recorded hold appropriated water rights as shown in Table I. Also, some of the older wells and watering ponds have vested groundwater rights. During this calendar year, hydrologists from the Regional Office prepared new water rights claims for the refuge. This undertaking was in response to the Montana Water Rights Adjudication law which stated that all filings prior to 1973 would have to be refiled. This was a major exercise but we feel that we will now have a better handle on our water rights situation. We have filed on many of the unnamed coulees which enter the refuge and have also claimed storage rights on the major tributaries - something which we never had before. With the completion of these filings - (they still have to be acted upon by a legal water court) - we will now have rights on all of our water uses.

Almost all of these rights should be granted because we had prior appropriated rights on the major streams and we had use rights on most of the other sources that would predate other claims. The importance of having legalized water claims cannot be emphasized enough for a waterfowl refuge. The agricultural and industrial economics of this area will be placing a greater impact on existing water in the very near future. See Table II for newly proposed water rights.

TABLE I WATER RIGHTS OF THE MEDICINE LAKE NATIONAL WILDLIFE REFUGE

| WATER RIGHTS FILING NUMBER | SOURCE | AMOUNT OF WATER RIGHT | ACRES UNDER WATER RIGHTS AND STORAGE RIGHTS |
|---|------------------------|--------------------------|---|
| 233163 | Cottonwood Creek | 100 cfs | 3640 |
| 233164 | Sand Creek | 75 cfs | 3640 |
| 233165 | Lost Creek | 25 cfs | 840 |
| 233166 | Sheep Creek | 20 cfs | 750 |
| 242886 | Sheep Creek | 300 cfs | 2287 |
| 233167 | Lake Creek | 100 cfs | 3640 and 3200 A/F Storage |
| 233168 | Big Muddy Creek | 50 cfs | 1600 |
| 233169 | Big Muddy Creek | 1200 cfs | 2000 and 55,000 A/F Storage |
| Vested Groundwater | Sandhills Well #1 | 3 gpm | |
| Appropriated Ground- water - No number | Sandhills Well #2 | 3 gpm | |
| Vested Groundwater | Headquarters Well | 300 gpm | |
| Appropriated Ground- water - No number | Headquarters Well | 25 gpm | |
| 373059 | Headquarters Well | 25 gpm | |
| Vested Groundwater | Stock Watering Pond #3 | 5 gpm | |
| Vested Groundwater | Stock Watering Pond #4 | 5 gpm | |
| Vested Groundwater | Stock Watering Pond #5 | 5 gpm | |
| Vested Groundwater | #2 Reed's Pond | 10 gpm | |
| Vested Groundwater | #1 Merganser Pond | 10 gpm | |

TABLE II. NEW WATER RIGHTS FILING PREPARED FOR THE MEDICINE LAKE NATIONAL WILDLIFE REFUGE BY REGIONAL OFFICE HYDROLOGISTS. THESE FILINGS COVER ALL EXISTING REFUGE RIGHTS PLUS ADDITIONAL NEW ONES.

| FILING NUMBER | USE | SOURCE | AMOUNT OF WATER RIGHT | VOLUME CLAIMED AF/YEAR |
|------------------|-----------------|---|------------------------------------|---------------------------|
| 1. | Fish & Wildlife | Big Muddy Creek Medicine Lake | 1200 cfs | 65000 |
| 2. | Fish & Wildlife | Groundwater Medicine Lake | * | * |
| 3. | Fish & Wildlife | Big Muddy Creek Homestead Lake | 50 cfs | 8000 |
| 4. | Fish & Wildlife | Sheep Creek Homestead Lake | 300 cfs | 7000 |
| 5. | Fish & Wildlife | Lost Creek Homestead Lake | 25 cfs | 4200 |
| 6. | Fish & Wildlife | Sheep Creek Homestead Lake | 20 cfs | 3750 |
| 7. | Fish & Wildlife | Unnamed Coulees French's Waterway | Natural Flow | 21.0 |
| 8. | Fish & Wildlife | Unnamed Coulee Barsness Pond | Natural Flow | 16.8 |
| 9. | Fish & Wildlife | Unnamed Coulees Barsness Pond East | Natural Flow | 9.6 |
| 10. | Fish & Wildlife | Unnamed Coulees Pond A&B Bolstad Coulee | Natural Flow | 11.2 |
| 11. | Fish & Wildlife | Unnamed Coulees & Spring Beaver Pond | Natural Flow 15 gpm from spring | 88.6 |
| 12. | Fish & Wildlife | Unnamed Coulees & Spring Merganser Pond | Natural Flow 15 gpm from spring | 24.0 |
| 12. | Stockwater | Unnamed Coulees & Spring Merganser Pond - Dugout | Natural Flow 10 gpm from spring | .14 |
| 13. | Fish & Wildlife | Unnamed Coulees & Spring Reeds Pond #2 | Natural Flow 10 gpm from spring | 19.6 |

| | | | | |
|-----|-----------------|---|------------------------------------|----------------------|
| 13. | Stockwater | Unnamed Coulees and Spring Reeds Pond #2 | Natural Flow 10 gpm from spring | .14 |
| 14. | Fish & Wildlife | Unnamed Coulees and Spring Stockwater Pond #3 | Natural Flow 5 gpm from spring | .65 |
| 14. | Stockwater | Unnamed Coulees and Spring Stockwater Pond #3 | Natural Flow 5 gpm from spring | .03 |
| 15. | Fish & Wildlife | Unnamed Coulees and Spring Stockwater Pond #4 | Natural Flow 5 gpm from spring | .65 |
| 15. | Stockwater | Unnamed Coulees and Spring Stockwater Pond #4 | Natural Flow 5 gpm from spring | .03 |
| 16. | Fish & Wildlife | Unnamed Coulees and Spring Stockwater Pond #5 | Natural Flow 5 gpm from spring | .65 |
| 16. | Stockwater | Unnamed Coulees and Spring Stockwater Pond #5 | Natural Flow 5 gpm from spring | .03 |
| 17. | Fish & Wildlife | Sandhill Well #1 | 3 gpm | 1.5 |
| 17. | Stockwater | Sandhill Well #1 | 3 gpm | .04 |
| 18. | Fish & Wildlife | Sandhill Well #3 | 25 gpm | 10.0 |
| 18. | Stockwater | Sandhill Well #3 | 25 gpm | .22 |
| 19. | Fish & Wildlife | Unnamed Coulee Pond J Section Coulee | Natural Flow. | 324 |
| 20. | Fish & Wildlife | Unnamed Coulee Ponds H & I Andreason's Coulee | Natural Flow | 80.5 (H) 92.7 (I) |
| 21. | Fish & Wildlife | Lake Creek Deep Lake, #12, & Katy's | 100 cfs | 21,400 |
| 22. | Fish & Wildlife | Cottonwood Creek #10 Lake, #11 Lake | 100 cfs | 18,200 |
| 23. | Fish & Wildlife | Unnamed Coulee, Pond G, Stringer's Coulee | Natural Flow | 10.4 |
| 24. | Fish & Wildlife | Sand Creek Gaffney Lake, Long Lake | 75 cfs | 18,200 |
| 25. | Fish & Wildlife | Unnamed Coulee Pond F Mrs. Henke's Coulee | Natural Flow | 5.7 |

| | | | | |
|-----|-------------------|----------------------|--------------|-----------|
| 26. | Fish and Wildlife | Unnamed Coulee | Natural Flow | 92.4 (D) |
| | | Ponds D & E | | 134.6 (E) |
| | | Lodahl's Coulee | | |
| 27. | Domestic | Headquarters Well #1 | 300 GPM | 10 |
| 28. | Domestic | Headquarters Well #2 | 25 gpm | 10 |

*To be determined after study by USGS

C. Purpose of Use

All diverted water was used as storage in impoundments, lakes, and marshes. This stored water provided waterfowl food and habitat and made it available to the waterfowl. Primary use is for the production and maintenance of waterfowl; marsh and water birds; shorebirds, gulls and terns; and raptorial birds. Secondary uses are for the fishery resource and resident wildlife species. Over-winter storage of water is necessary to sustain a viable aquatic insect population, an aquatic plant regime, and the fishery resource.

All wells and ponds were used for wildlife, livestock, and domestic purposes.

D. Season of Use

The main season of water use is generally from mid-March until the first part of December. Adequate water supplies are especially important from mid-March to late July for waterfowl pairing and brooding. The fall period, from mid-September to mid-November is also important for migrating waterfowl. The lake and impoundments are usually frozen over from early December through the end of March every year but the marshes, ponds and lake edges start opening by mid-March, especially if run-off has started.

During the winter season, water is used to carry over resident fish and wildlife populations.

The main well at headquarters site is used year round for domestic purposes. The secondary well at headquarters is used for irrigation of lawns and gardens from mid-May until September 1.

The wind driven wells in the Sandhills are used for wildlife and livestock watering purposes - usually from May 1 until November 1.

E. Quantity Used

A total of 7858.7 acre feet of water entered the refuge via creek channels during the 1981 spring run-off period. No other run-off water was received during the year but June rainfall did add some water directly to the management units. All of the water that flowed down the main creek channels was diverted for refuge use. The Big Muddy Creek contributed 5682.5 A/F of water to the main lake. Of this total, 3143.7 A/F were released through #4 structure and then diverted into the Homestead Unit via the Indian Service Dam. All of the water coming down Lake Creek, Cottonwood Creek, and Sand Creek (a combined total of 2176.2 A/F) was diverted into the east refuge impoundments. None of this water entered the main lake.

Total water used by the refuge during the year was 17,670.1 A/F. All of this "used" water was lost to evaporation and groundwater seepage. An estimated twenty acre feet of groundwater was pumped from four refuge wells. No data is available on the amount of water used in ponds and coulee dams.

TABLE III. Major Impoundment Water Deficiencies - Spring and Fall - 1981

| AREA | Deficiency in Acre/Feet | | Tributary Stream |
|-------------------------|-------------------------|-----------|--|
| | Spring 1981 | Fall 1981 | |
| Homestead Lake | 4,298.0 | 5992.6 | Big Muddy Creek Lost Creek Sheep Creek |
| Gaffney Lake | 2,442.3 | 3,022.2 | Cottonwood Creek Lake Creek Sand Creek |
| #10 Lake | 266.0 | 356.4 | Cottonwood Creek Lake Creek Sand Creek |
| Deep Lake | 403.4 | 286.9 | Cottonwood Creek Lake Creek Sand Creek |
| Long Lake | 290.6 | 376.5 | Cottonwood Creek Lake Creek Sand Creek |
| #11 Lake | 405.3 | 401.5 | Cottonwood Creek Lake Creek Sand Creek |
| #12 Lake | 728.4 | 1,198.0 | Lake Creek |
| Katy's Lake | 661.4 | 705.1 | Lake Creek |
| Medicine Lake | 23,001.8 | 29,969.4 | Big Muddy Creek |
| <u>Total Deficiency</u> | 32,497.2 | 42,308.6 | |

F. Place of Use

TABLE III compares the water deficiency of each major refuge impoundment between spring of 1981 and the fall of 1981. The spring total is actually the deficiency from 1980 while the fall total is the deficiency from 1981. The table also lists the tributary streams that fill each unit.

G. Adequacy of Supply

Spring run-off was only enough to bring two impoundments up to operational capacity. The #11 lake unit and the #10 lake unit reached their spill elevations. Water was by-passed from #11 lake into #10 lake and from #10 lake into Deep Lake (primarily) and Gaffney Lake. Water released from Medicine Lake to the Homestead Unit was enough to fill that unit to one-half of its capacity.

TABLE IV shows the amount of water received from each tributary stream. When you compare this with TABLE III you can easily see that the supply did not meet the demand.

TABLE IV. Water Received Per Tributary Stream - 1981
(parenthesis - 1980)

| | | |
|--------------------|-------------|-----------|
| Big Muddy Creek | 5682.5 A/F | (1563) |
| Lost Creek | 0 | (0) |
| Sheep Creek | 0 | (.5) |
| — Sand Creek | 188.3 A/F | (286.5) |
| — Cottonwood Creek | 1,598.2 A/F | (48.1) |
| — Lake Creek | 389.7 A/F | (578.6) |
| Total Received | 7,858.7 | (2,476.7) |

Precipitation every month of the year was well below the average except for June when almost two inches more than normal fell. This was the only month that impoundments gained from rainfall. Hot, windy, dry weather during April, May, July, and August lowered water levels significantly due to evaporation loss. The heavy rainfall in June provided enough moisture for average vegetative growth but dry weather the rest of the year depleted soil moisture almost totally and lowered groundwater levels.

It should be noted under this section that many small wetlands on the refuge have completely dried up. Some wetlands like Lodahl's Coulee, Merganser Pond, and French's Waterway have not been completely dry for over 15 years, but they were dry this year. Homestead Lake, the second largest impoundment on the refuge with 1,220 surface acres, was 95% dry by freeze-up. It would have been totally dry had we not partially filled it with water from Medicine Lake in the spring.

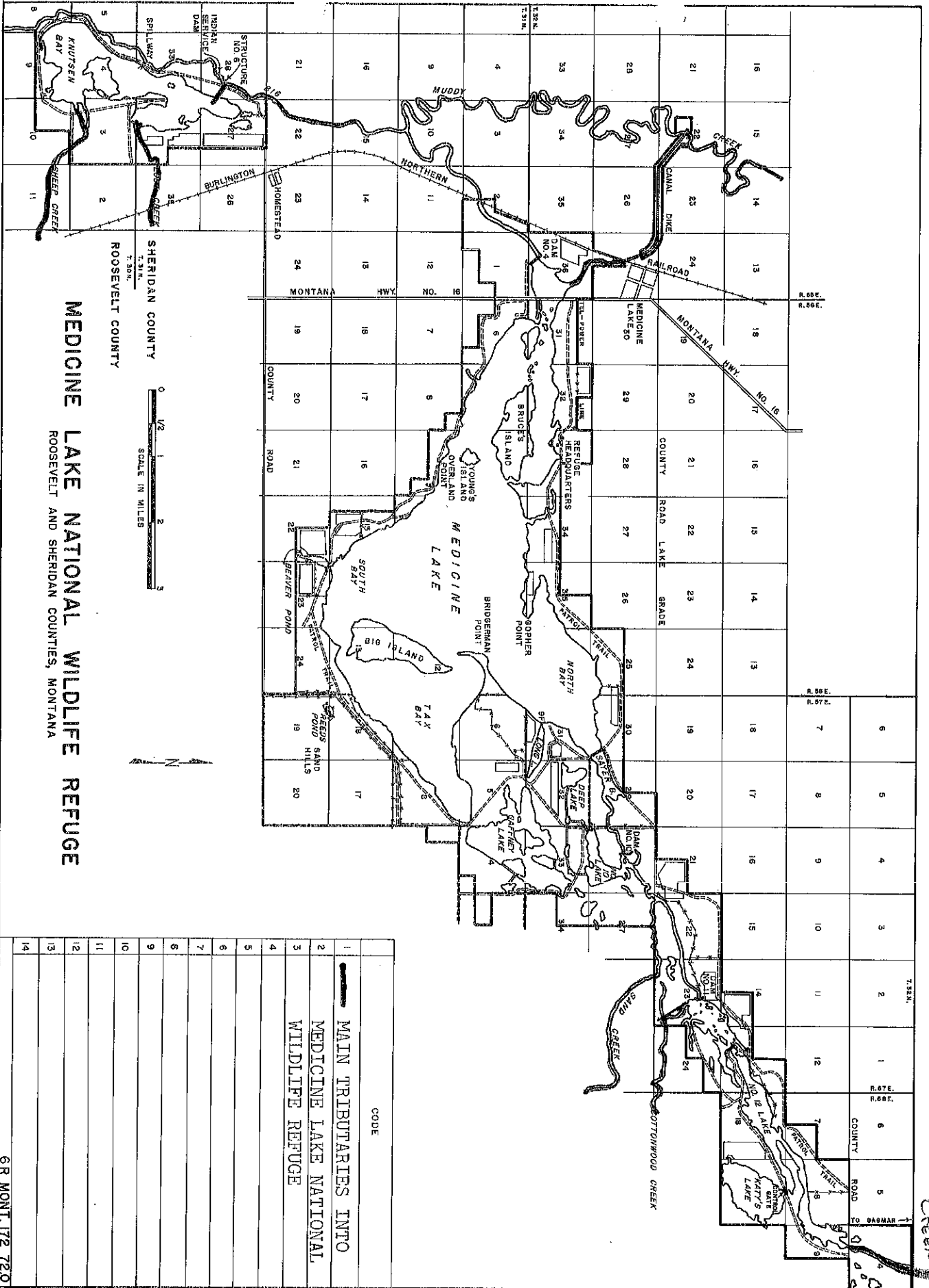


TABLE V. Annual Precipitation Amounts (Inches)

| Month | <u>1981</u> | | <u>1980</u> | | Normal Precipitation |
|-----------|------------------|----------|------------------|----------|-------------------------|
| | Total Precip. | Snowfall | Total Precip. | Snowfall | |
| January | .01 | .5 | .47 | 5.75 | .43 |
| February | .08 | 1.0 | .10 | 1.0 | .39 |
| March | .30 | | .34 | 3.0 | .37 |
| April | .77 | | .33 | | 1.24 |
| May | 1.16 | | .56 | | 1.78 |
| June | 5.28 | | 3.22 | | 3.45 |
| July | 1.17 | | .69 | | 2.12 |
| August | .40 | | 3.37 | | 1.68 |
| September | .90 | | 1.49 | | 1.17 |
| October | .65 | | .91 | 5.0 | .71 |
| November | .41 | 4.0 | .31 | 3.0 | .51 |
| December | .19 | 3.0 | .46 | 6.0 | .33 |
| TOTAL | 11.32 | 8.5 | 12.25 | 23.75 | 14.18 |

TABLE VI. MONTHLY RECORD OF GAUGE READINGS - 1981

| | Homestead Lake | Gaffney's Lake | #10 Lake | Deep Lake | Long Lake | #11 Lake | #12 Lake | Katy's Lake | Medicine Lake |
|----------------------|----------------|----------------|----------|-----------|------------|----------|----------|-------------|---------------|
| OPERATIONAL LEVEL ** | 1937.65 | 1945.00 | 1945.80 | 1946.20 | 1945.00 | 1953.00 | 1956.00 | 1954.40 | 1943.02 |
| JANUARY | 1933.40(T) | 1941.31(T) | 1944.80 | 1942.15 | 1940.90(T) | 1950.88 | 1954.48 | 1952.78 | 1940.28 |
| FEB RY | 1933.40 | 1941.31 | 1945.60 | 1944.90 | 1940.90 | 1952.46 | 1954.48 | 1953.28 | 1941.26 |
| MARCH | 1935.48 | * | 1945.74 | 1945.64 | * | 1952.02 | 1954.52 | 1953.06 | 1940.92 |
| APRIL | 1935.72 | * | 1945.64 | 1945.52 | * | 1951.80 | 1954.76 | 1953.02 | 1940.90 |
| MAY | 1935.28 | * | 1945.58 | 1945.30 | 1940.62(T) | 1951.70 | 1954.84 | 1952.92 | 1940.76 |
| JUNE | * | * | 1945.70 | 1945.48 | * | 1952.00 | 1955.18 | 1953.16 | * |
| JULY | 1933.40 | * | 1945.36 | 1945.04 | * | 1951.76 | 1954.96 | 1952.98 | 1940.56 |
| AUGUST | * | * | 1944.86 | 1944.42 | * | 1951.26 | 1954.26 | 1952.54 | 1940.14 |
| SEPTEMBER | * | * | 1944.28 | 1943.66 | * | 1950.82 | 1953.68 | 1952.20 | 1939.60 |
| OCTOBER | * | 1940.31(T) | 1944.26 | 1943.40 | 1939.56(T) | 1950.76 | 1953.48 | 1952.20 | 1939.49 |
| NOVEMBER | * | * | * | * | * | * | * | * | * |
| DECEMBER | 1932.77(T) | 1940.31 | 1944.46 | 1943.32 | 1939.56 | 1950.90 | 1953.50 | 1952.14 | 1939.45 |

* Not available

(T) Transit reading because water level was below gauge.

** It should be noted that although these operational levels may be different than previous plans (prior to 1980), it is only because they have been recalculated to correct MSL readings. It was found that many of the gauges were incorrectly set. The approved actual water levels remain unchanged.

TABLE VII. Comparison of Water Deficiencies* - Acre Feet Needed

| IMPOUNDMENT | 1982 | 1981 | 1980 | 1979 | 1978 | 1977 | 1976. | 1975 |
|----------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Homestead Lake | 5993 | 4298 | 2028 | 4199 | 2648 | 2002 | 1589 | 2648 |
| Gaffney's Lake | 3022 | 2442 | 547 | 214 | 842 | 641 | ** | 427 |
| #10 Lake | 356 | 266 | 23 | 23 | 97 | 131 | ** | 89 |
| Deep Lake | 287 | 403 | 34 | 23 | 57 | 52 | ** | 52 |
| Long Lake | 377 | 291 | 76 | 30 | 149 | 89 | ** | 89 |
| #11 Lake | 402 | 405 | 288 | 174 | 462 | 307 | 250 | 386 |
| #12 Lake | 1198 | 729 | 620 | 286 | 1324 | 968 | 1785 | 991 |
| Katy's Lake | 705 | 661 | 334 | 183 | 330 | 484 | 325 | 588 |
| Medicine Lake | 29969 | 23002 | 11921 | 5205 | 19980 | 9738 | 3862 | 11249 |
| TOTALS | 42309 | 32497 | 15871 | 10337 | 25898 | 14412 | 7811 | 16519 |

* Deficiencies are based on water elevations on January 1 of each year.

** At or above operational level.

H. Improvements to Water Facilities During 1981

Two major improvements to water facilities were started during 1981. A BLHP contract was let for the construction of the Sayer Bay Dam and the refuge is constructing the Sheep Creek #2 Dam by force account. When these two projects are completed, the refuge will have developed all of its major impoundments. There are still some areas that could be impounded, but additional private lands would either have to be bought or have storage easements taken on them.

The Sayer Bay Dam will create a new permanent shallow marsh approximately 170 acres in size. It will be located along the northeast section of the main lake.

The Sheep Creek Dam #2 is being built immediately below the Sheep Creek impoundment in the Homestead Unit. This dam will create a 60 acre marsh.

We replaced water guages on all impoundments during 1980 to bring them in align with correct MSL readings. These MSL readings were set by using original construction blueprints of the control structures. It has been found this year, that two of the structures were not built to blueprint specs. The flowline on Katy's Lake structure was reported at 1952.00 MSL but is actually at 1952.40 MSL. The #6 spillway at Homestead was reported at 1933.00 MSL but is probably more like 1935.50 MSL. We will have to run a transit level on this elevation from the bench mark on the Indian Service Dam.

Washouts in the main spillway on #11 dam were filled and rocked up to the approved elevation.

II. Recommendations for 1982

The refuge will need 42,309 acre feet of water in the spring of 1982 to bring all impoundments to operational level. Normal average spring flows should be sufficient even for this large deficit. As of this writing, we have a snowpack of about 8 inches. If a normal winter continues and we have a moderately fast snowmelt, there will be sufficient water.

The following recommendations are being made for water management on Medicine Lake National Wildlife Refuge during 1982.

1. All impoundments should be filled to operational level as early as possible.
2. Once run-off starts and it is evident that run-off is going to be excessive to the impoundment needs - water should be released through control structures to allow for the best flushing action possible. If water is allowed to flow over the spillway only, a good flushing will not occur.
3. Water that enters the refuge from the east end via Lake Creek, Cottonwood Creek, and Sand Creek should be utilized in filling the upper impoundments to operational level before any is released into Medicine Lake. Here again, if water flow looks like it will be excessive into #12 Lake, the gate into Katy's Lake should be opened before #12 Lake reaches operational level. If flow will be excessive for #10 Lake, the gates into Deep Lake and Gaffney Lake should be opened early also.
4. Continue water chemistry readings, i.e. salinity and conductivity on all impoundments (spring and fall), on all inflows, and on all discharges.
5. Homestead Lake has a high botulism potential. In past years, it has been necessary to drawdown this lake to help combat the outbreaks. If botulism breaks out again, we recommend the unit be drawn down to its lowest level. This will dewater the southern third of the lake and will pull all of the water out of the bullrush - once the botulism danger no longer exists, the lake should be refilled for fall migration.
6. The potential for botulism outbreaks is also quite high in the marshes associated with #10 Lake, Gaffney Lake, and Medicine Lake - west of highway. These areas become hotspots after quick rises in water levels associated with heavy summer thunderstorms. These areas should be watched and water levels kept as stable as possible.
7. If spring run-off down the Big Muddy Creek is going to be inadequate to fill both Medicine Lake and Homestead Lake, we recommend by-passing water through the #4 structure on Medicine Lake to fill Homestead Lake within at least one foot of operational level. This water level in Homestead Lake will make most water areas available to pairing and nesting waterfowl. It would take a release of approximately 3,500 acre feet of

water to accomplish this. (Note: Medicine Lake itself will have to receive at least 8,000 acre feet of water before any releases can be made. This is because of the low water conditions.) This water could also be diverted to the Homestead Unit by closing the diversion structure and routing it through the #1 dam. It is however easier and more efficient to run the water into Medicine Lake and out of the #4 structure.

8. Hold water as high as possible in Medicine Lake (except for above noted recommendations) to accomplish several refuge objectives. (These objectives are:

- A. Increase waterfowl production by providing more available pairing area.
- B. Provide maximum nesting habitat for grebes and other marsh nesting birds.
- C. Provide spawning habitat for northern pike. This will assure a good northern population to help naturally control carp and also provide for additional recreation opportunities.
- D. Insure adequate water levels for over wintering resident wildlife and fish populations.

9. Water in excess of what is needed to obtain approved operational levels will be diverted or released to the next impoundment downstream. Excess water in Medicine Lake or Homestead Lake will be released back into the Muddy Creek drainage.

10. With the completion of the diversion structure in 1980, every effort should be made to keep silt laden waters in the Big Muddy Creek from entering the refuge. These high silt loads generally occur as a result of heavy summer rains. We do recommend however, that if water needs are not met by spring run-off, all waters should be diverted into the refuge. If the lake is at or close to operational level, the diversion structure should be closed during heavy silt load flows and the water diverted through #1 dam down the Big Muddy Creek to the Homestead Unit where it can either be utilized or diverted on downstream through the Indian Service Dam.

11. Proposed Water Use Priority

| Unit | Purpose | Priority |
|----------------|---|----------|
| #12 | Nesting and brooding, storage, fish rearing | 1 |
| Katy's Lake | Nesting and brooding, storage | 1 |
| #11 Lake | Nesting and brooding, storage | 1 |
| #10 Lake | Nesting and brooding, storage | 1 |
| Gaffney Lake | Nesting and brooding, storage | 2 |
| Deep Lake | Nesting and brooding, storage | 1 |
| Long Lake | Nesting and brooding, storage | 2 |
| Sayer Bay | Nesting and brooding | 1 |
| Medicine Lake | Nesting and brooding, storage, fish rearing | 2 |
| Homestead Lake | Nesting and brooding, storage | 1 |
| Sheep Creek #1 | Nesting and brooding | 1 |
| Sheep Creek #2 | Nesting and brooding | 1 |

TABLE VIII. 1981 Water Deficiency

| NAME OF LAKE | Elevation 01/01/81 | Operating Elevation | Elevation Difference | Acre Feet Needed | Surface Acres at Oper. Level |
|----------------|--------------------|---------------------|----------------------|------------------|------------------------------|
| Homestead Lake | 1932.40 | 1935.90* | 3.50 | 4298.0 | 1228.0** |
| Gaffney Lake | 1941.31 | 1945.10* | 3.79 | 2442.3 | 644.4** |
| #10 Lake | 1944.80 | 1945.80* | 1.00 | 266.0 | 266.0** |
| Deep Lake | 1942.15 | 1946.20* | 4.05 | 403.4 | 99.6** |
| Long Lake | 1940.90 | 1945.10* | 4.20 | 290.6 | 69.2** |
| #11 Lake | 1950.88 | 1953.00* | 2.12 | 405.3 | 191.2** |
| #12 Lake | 1954.48 | 1956.00* | 1.52 | 728.4 | 479.2** |
| Katy's Lake | 1951.88 | 1954.00* | 2.12 | 661.4 | 312.0** |
| Main Lake | 1940.28 | 1943.02* | 2.74 | 23001.8 | 8394.8 |

32497.2

* Operational elevations reset with new water gauges.

** Acreages recalculated (surface only) (volume/gradient tables needed)

1981 Resume

1981 Water Flow Data and Water Deficiency

Water deficiency in A/F on January 1, 1981 - 32,497.2

Total water flow in A/F received by the refuge.

Spring flow - 7,858.7

Summer flow - None

Excess water diverted from the refuge - none

Spring flow - none

Homestead drawdown - none

Water diverted from main lake to Homestead unit - 3143.7

Water deficiency in A/F on December 31, 1981 - 42,308.6

Total water inflow in A/F utilized by refuge in 1981 - 7858.7

Total water utilized (lost to evaporation) by refuge - 17670.1 A/F

1981 Water Flows Received by Tributary

| | | | |
|-----------------|----------------|------------|----------------|
| Big Muddy Creek | 5683 Acre Feet | Sand Creek | 188 Acre feet |
| Lost Creek | 0 | Lake Creek | 390 Acre feet |
| Sheep Creek | 0 | Cottonwood | 1598 Acre Feet |

1981TABLE IX. Water Chemistry Readings on Tributary Streams - Spring Inflow

| LOCATION | Date | Temp. °C | Salinity Parts/1000 | Conductivity Micromho/cent. | Comments |
|------------------|---------|----------|------------------------|--------------------------------|------------------------------|
| Muddy Creek | 2/17/81 | 1° | 2.0 | 2150 | Taken at Diversion Structure |
| Muddy Creek | 2/23/81 | 2° | .0 | 240 | Taken at Diversion Structure |
| Muddy Creek | 4/21/81 | 13° | .9 | 1400 | Taken at Diversion Structure |
| Cottonwood Creek | 2/17/81 | 2° | .0 | 200 | Taken on County Road Bridge |
| Lake Creek | 2/17/81 | 2° | .5 | 800 | Taken at Buster's Dam |
| Lake Creek | 4/21/81 | 9° | .2 | 880 | Taken at Buster's Dam |
| Sand Creek | 2/18/81 | - .25° | .25 | 600 | Taken at Lake Grade Culvert |
| Muddy Creek | 3/31/81 | 10° | .1 | 1000 | Taken at Homestead Inlet |

TABLE X. Water Chemistry Readings on Impoundments - Spring*

| Impoundment | Location | Temperature °C | Salinity Parts/1000 | Conductivity Micromho/cent. | Comments |
|----------------|----------|-------------------|------------------------|--------------------------------|--|
| Medicine Lake | 1A | 13° | 1.0 | 1850 | Taken in Bruce's Island Narrows |
| Medicine Lake | 1B | 12° | 1.1 | 1810 | Taken 50 yds. out from 9F |
| Gaffney Lake | 2A | 13° | 1.2 | 2120 | Taken 100 yds. out from end of outlet |
| Gaffney Lake | 2B | 14° | 1.6 | 2200 | Taken 100 yds. out from end of island canal |
| #10 Lake | 3 | 12° | 1.2 | 1910 | Taken 100 yds. out from end of outlet on Gaffney |
| Deep Lake | 4 | 11° | 1.9 | 2520 | Taken 100 ft. out from north bank |
| #12 Lake | 5 | 12° | .8 | 1290 | Taken 100 ft. out from #12 dam |
| Katy's Lake | 6 | 13° | 4.2 | 5900 | Taken 100 yds out from structure |
| #11 Lake | 7 | 12° | 1.2 | 2100 | Taken 100' below #12 dam |
| Homestead Lake | 8A | 11° | 1.6 | 2320 | Taken in canal between north lakes |
| Homestead Lake | 8B | 14° | 1.1 | 2050 | Taken 100 yds into Lost Creek Bay |

* Readings taken on April 21, 1981, after run-off from tributary streams.

TABLE XI. Water Chemistry Readings on Impoundments - Fall*

| Impoundment | Location | Temperature °C | Salinity Parts/1000 | Conductivity Micromho/cent. | Comments |
|----------------|----------|-------------------|------------------------|--------------------------------|---|
| Medicine Lake | 1A | 2.5 | 2.0 | 2050 | Taken in Bruce's Island narrows. |
| Medicine Lake | 1B | 1.0 | 1.7 | 1860 | Taken 50 yds. out from 9F |
| Gaffney Lake | 2A | 1.0 | 2.0 | 2210 | Taken 100 yds. out from end of outlet |
| Gaffney Lake | 2B | 2.0 | 2.0 | 2290 | Taken 100 yds out from end of island canal |
| #10 Lake | 3 | 1.8 | 2.3 | 2520 | Taken 100 yds out from end of outlet on Gaffney |
| Deep Lake | 4 | 2.0 | 2.9 | 2830 | Taken 100 ft. out from north bank |
| #12 Lake | 5 | 3.0 | 1.0 | 1530 | Taken 100 ft. out from #12 dam |
| Katy's Lake | 6 | 0.3 | 7.5 | 7050 | Taken 100 yds. out from structure |
| #11 Lake | 7 | 1.1 | 3.5 | 3620 | Taken 100 ft. below #12 dam |
| Homestead Lake | 8A | 2.0 | 3.0 | 3400 | Taken in canal between north lakes |
| Homestead Lake | 8B | 0 | 10.8 | 10000 | Taken 100 yds into Lost Creek Bay |

* Taken December 7, 1981, through 3" of ice.